

For steam services the actual condensation weight is taken without any allowance for heating effect; for hot water services the weight of circulated water is used without allowance for heating effect. In all cases the total heat transmission varies as the 1.3 power for radiators<sup>11</sup> and the 1.5 power for convectors<sup>12</sup> of the temperature difference between that inside the radiator and the air in the room, and is expressed in Btu or Mb per hour.

Standard test conditions specify either a steam pressure of 1 lb gage 15.6 lb per sq in. absolute (215 F) or an average hot water temperature of 170 F and a room temperature of 70 F (5 ft above floor) for radiators, or an inlet air temperature of 65 F for convectors. The heating capacity of a *steam radiator* or *steam convector* is determined as follows:

$$H_t = W_s h_{fg} \quad (1)$$

where

$H_t$  = Btu per hour under test conditions.

$W_s$  = condensation in pounds per hour.

$h_{fg}$  = latent heat in Btu per pound.

$H_t$  may be converted to standard conditions of code ratings by using the proper correction factor from the following formulae:

For radiators:

$$C_s = \left( \frac{215 - 70}{T_s - T_r} \right)^{1.3} = \left( \frac{145}{T_s - T_r} \right)^{1.3} \quad (2)$$

For convectors:

$$C_s = \left( \frac{215 - 65}{T_s - T_i} \right)^{1.5} = \left( \frac{150}{T_s - T_i} \right)^{1.5} \quad (3)$$

The output under standard conditions will be:

$$H_s = C_s H_t \quad (4)$$

where

$C_s$  = correction factor.

$T_s$  = steam temperature during test, degrees Fahrenheit.

$T_r$  = room temperature during test, degrees Fahrenheit.

$T_i$  = inlet air temperature during test, degrees Fahrenheit.

$H_s$  = heat emission rating under standard conditions, Btu per hour.

Similarly, for *hot water convectors*, the output under test conditions may be determined as follows:

$$H = W (\theta_1 - \theta_2) \frac{3600}{t} \quad (5)$$

where

$H$  = Btu per hour under test conditions.

$W$  = pounds of water handled during test.

$\theta_1$  = average temperature of inlet water, degrees Fahrenheit.

$\theta_2$  = average temperature of outlet water, degrees Fahrenheit.

$t$  = duration of test, seconds.

<sup>11</sup>Loc. Cit. Note 9.

<sup>12</sup>Loc. Cit. Notes 9 and 10.

To convert test results to standard conditions, the following correction factor is used:

$$C = \left( \frac{170 - 65}{\frac{\theta_1 + \theta_2}{2} - T_i} \right)^{1.5} = \left( \frac{105}{\frac{\theta_1 + \theta_2}{2} - T_i} \right)^{1.5} \quad (6)$$

It has been shown that when the exponent 1.5 is used the range of error is less than 3 per cent<sup>13</sup> for convectors.

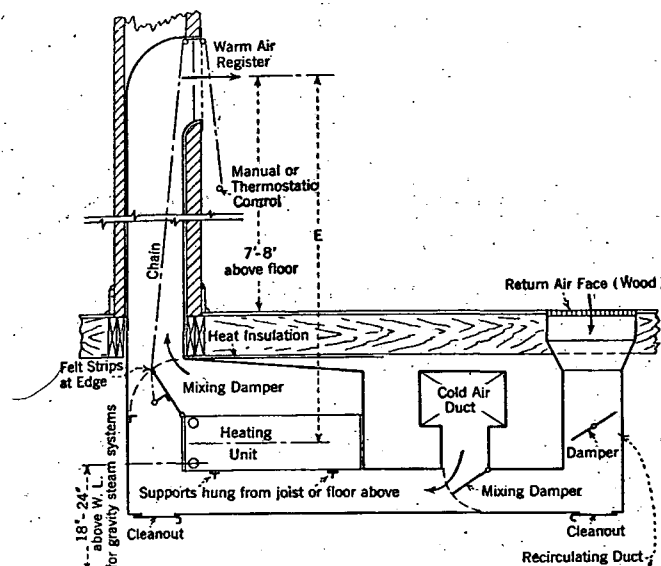


FIG. 6. GRAVITY-INDIRECT HEATING SYSTEM

### GRAVITY-INDIRECT HEATING SYSTEMS

The heating units for this system are usually of the extended surface type for steam or hot water, and are installed about as shown in Fig. 6. The temperature and volume of the air leaving the register must be great enough so that in cooling to room temperature the heat available will just equal the heat loss during the same time. To establish and maintain a constant heat flow, provision must be made for removing the air in the room, after it has cooled to the desired room temperature, by a system of vent flues or ducts. As the air flow is maintained by natural draft and this gravity head is very slight, it is necessary to make all ducts as short as possible, especially the runs from the heating units to the base of the vertical warm air flues. Gravity-indirect arrangements, such as illus-

<sup>13</sup>Loc. Cit. Note 10.